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CONTENTS

Liquefaction of helium.
Sunlight and daylight filters.
Methods and apparatus used in spectrophotometry.
Two new crystalline difructose anhydrides from hydrolyzed inulin.
Purity of reagent chemicals.
The vibration of U bars.
Turbulence in wind tunnels.
Wind pressure on a model of a mill building.
Progress in aeronautic radio research.
Domestic gas burners.
Pipe-line currents and soil resistivity.
Water penetration through brick and mortar.
Modulus of rupture of some Ohio heavy clays.
Thermal expansion of some soda-lime glasses.
Phormium tenax for paper making.
Certification and labeling.
New and revised publications issued during March, 1931.
Letter circulars prepared during March, 1931.
Recent articles appearing in outside publications.

LIQUEFACTION OF HELIUM

On April 4, Dr. George K. Burgess, Director of the National Bureau of Standards announced that helium had been liquefied in the bureau's cryogenic laboratory on the afternoon of Friday, April 3. Liquid helium temperatures were maintained for two hours, and a temperature of —271.2° C. (—456° F.) was reached, which is only 1.9° C. (3.4° F.) above absolute zero, —273.1° C. (—459.4° F.). The temperature of liquid helium at atmospheric pressure is —269° C. (—452° F.), but it can be cooled further by reducing the pressure of the helium vapors over the boiling liquid with a vacuum pump. As a result of many months of work in the cryogenic laboratory not only was the liquefaction of helium accomplished for the first time in the United States, but also the lowest temperatures ever attained in this country were reached.

The helium liquefier was operated for the first time on March 18, at which time it is believed liquid helium was produced. The positive evidence of the presence of liquid helium obtained April 3 was not obtained March 18, since the apparatus with which it was proved that liquid helium was being produced was added after the experiment of March 18; however, no changes had been made in the liquefier. The successful production of liquid helium will permit the bureau to extend its investigations of the properties of matter to the lowest attainable temperatures. It may also assist in the establishment of a new low fixed point on the International Temperature Scale, the establishment of these natural constants being one of the primary functions of the bureau.

The initial step in the process of liquefaction of helium is the purification of the gas to remove substances which would otherwise freeze in the liquefier and stop the flow, since at liquid helium temperatures, all substances with the single exception of helium are solids. After purification the gas enters the liquefier which is inclosed in a metal case surrounded, except for an opening at the top, with liquid air at a temperature of —190° C. (—310° F.). In the liquefier the helium expands through a valve from a high pressure to a low pressure. The helium in expanding becomes colder and the refrigeration effect is used to lower the temperature of the compressed helium that follows it. The temperature continues to fall until the liquefaction point is reached, —269° C. (—452° F.). It is necessary to reduce the temperature of the compressed helium before expansion, with solid or liquid hydrogen as otherwise the helium would become warmer instead of colder. Liquid hydrogen boils at —253° C. (—423° F.) and freezes at —259° C. (—434° F.). In order to liquefy helium, it was necessary, therefore, to make first liquid air and liquid hydrogen. In the liquefier the helium flows through a series of coils of metal tubing suspended inside a succession

of metal cases and vacuum jacketed vessels so arranged as to prevent as far as possible any transfer of heat to the coldest parts of the liquefier from a warmer exterior. The amount of refrigeration that is generated is so small that the success of the apparatus depends on obtaining almost perfect insulation.

Proof of the presence of liquid helium was obtained by two independent methods. The temperatures were measured with a vapor-pressure thermometer filled with helium, the bulb of which was immersed in the receiver of the liquefier in which the liquid helium collected. The bulb was connected to a mercury manometer outside the liquefier. The vapor pressure of the liquid helium in the bulb was determined by measuring the length of a column of mercury which the vapor would support. Using a known relation connecting the vapor pressure of helium with its temperature, the temperatures of the liquid helium in the liquefier were determined. The vapor pressure thermometer was so made that the volume of the vapor space could be changed by raising or lowering the levels of mercury columns in a large glass bulb and in an auxiliary glass tube. The fact that the vapor pressure, as read on the mercury manometer, did not depend upon the volume of the vapor space was proof of the presence of liquid helium. In order to obtain still further evidence, a lead and tin electrical resistance unit was constructed and placed in the liquid helium reservoir beside the bulb of the vapor-pressure thermometer. It is already known that lead loses all of its electrical resistance and becomes a perfect conductor at —266° C. (—448° F.) and that the same is true for tin at —269° C. (—453° F.). This is called supraconductivity. That these temperatures were attained was, therefore, proved by the fact that both the tin and the lead lost their resistance and became supraconducting.

This phenomenon of supraconductivity is only one of the strange effects of these very low temperatures. Although tin, lead, mercury, and a number of other metallic elements and alloys become perfect conductors, metals like copper, gold, and silver, which at ordinary temperatures are the best conductors, do not become supraconducting, so that the metals which at ordinary temperatures are considered poorer conductors become infinitely better conductors at liquid helium temperatures than copper, gold, and silver.

Helium has been liquefied before in three other countries, first in Holland at the University of Leiden, next in Canada at the University of Toronto, and then in Germany at the Reichsanstalt and at the University of Berlin. The liquefier constructed by the National Bureau of Standards is essentially like the one designed by Dr. Martin Ruhemann and used by him to make liquid helium at the University of Berlin. Some changes in the nature of improvements have been made.

SUNLIGHT AND DAYLIGHT FILTERS

Miscellaneous Publication No. 114 of the Bureau of Standards which was released last month, deals with filters for the reproduction of sunlight and daylight, and the determination of color temperature. For scientific and technical use in photographic sensitometry, colorimetry, and photometry, the following filters, reproducible from specification, have been developed:

1. A series of filters by means of which the spectral energy distribution of a Planckian radiator (black body) at any temperature from 2,300° to 4,000° K, inclusive, may be converted into a close approximation of the spectral energy distribution of mean noon sunlight at Washington. The data cover the range from 350 to 720 millimicrons. Light transmissions have been computed for all the filters.

2. By designing these filters so that they all give an exact color match with the adopted mean sunlight, in addition to a close energy match, they may be used to calibrate the intensity and color temperature of incandescent lamps at any color temperature above 2,300° K, provided a source is available calibrated for intensity and color temperature at some one color temperature within this range. The comparison of intensities of incandescent lamps at different color temperatures may thus be made under conditions of exact color match.

3. A second series of filters has been developed for converting the color of a Planckian radiator at 2,848° K. to that of any Planckian radiator between 3,500° and 10,000° K., inclusive.

4. Seven additional filters, not in the above series, are also described, viz:

(*a*) A filter for converting 2,848° K. to the color of the sun outside of the earth's atmosphere, which satisfactorily represents the color of overcast sky, this filter thus affording a reproducible daylight standard. By com-

bining this filter with sources at various color temperatures between 2,300° and 3,000° K., colors closely matching various phases of sunlight and daylight may be obtained.

(*b*) A filter for converting 2,848° K. to Abbot-Priest sunlight.

(*c*) A filter for converting acetylene to mean noon sunlight at Washington.

(*d*) and (*e*) Two filters, one for converting 2,848° K. to noon sunlight at the summer solstice at Washington and the other for converting 2,848° K. to noon sunlight at the winter solstice at Washington.

(*f*) and (*g*) Two filters designed to cover a wide range of black-body color temperatures by varying the color temperature of the light source between the limits of 2,000° and 3,100° K. With this variation one of the filters covers the black-body scale from 2,650° to 5,000° K. and the other from 4,000° to 19,000° K.

The filters consist of a 2-compartment cell with three borosilicate crown glass windows, the two compartments being filled, respectively, with solutions A and B, having compositions as follows:

Solution A

Copper sulphate ($CuSO_4.5H_2O$)	grams	c
Mannite ($_6H_8(AH)_6$)	do	c
Pyridine (C_5H_5N)	cubic centimeters	30.0
Water (distilled) to make	do	1,000

Solution B

Copper sulphate ($CuSO_4.5H_2O$)	grams	c_1
Cobalt ammonium sulphate ($CoSO_4.(NH_4)_2SO_4.6H_2O$)	do	c_2
Sulphuric acid (specific gravity, 1.835)	cubic centimeters	10.0
Water (distilled) to make	do	1,000

The values of c, c_1, and c_2 vary from one filter to another.

The design of the filters has been based upon extensive spectrophotometric measurements of the component solutions and cell, including a study of Beer's law over the ranges of concentrations used, and upon methods of computation giving accurate color matches and relatively good spectral energy matches between the source-and-filter combination and the energy distribution which it was sought to duplicate. Detailed studies have been made of the reliability of the data, the spectrophotometric reproducibility of the chemicals, the permanence of the solutions, their temperature coefficients, and various other factors of importance in the preparation and use of the filters.

The paper contains 33 illustrations and 26 tables, giving among other things the energy distributions and fundamental spectrophotometric and colorimetric data used in the computations, auxiliary spectrophotometric and colorimetric information obtained during the investigation, and the trilinear coordinates of the various source-and-filter combinations and of the Planckian radiator from 1,600° to 20,000° K, computed on the basis of the adopted mean sun as the "neutral" stimulus. The filters are further described in 38 charts, each chart giving the chemical formula, the spectral transmission, and the light transmission of the filter, as well as the spectral energy distribution of the source, that of the source and filter combined, and the energy distribution which serves as the ideal in that particular case.

Copies of this publication may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 45 cents each.

METHODS AND APPARATUS USED IN SPECTROPHOTOMETRY

In a paper which has been prepared for the Journal of the Optical Society of America brief descriptions are given of the methods and apparatus used in making spectrophotometric measurements in the colorimetry section of the bureau. Full descriptions have been given in the publications to which reference is made. What is noted particularly in the present paper are those features of the methods which tend to insure reliability in the values obtained. It is shown that the photometric scale of the Koenig-Martens spectrophotometer can be independently checked and greatly extended by means of the rotating sectors. The means taken to eliminate wave-length, slit-width, and stray-light errors are noted, particularly the use of homogeneous light of certain wave lengths in the measurement of transmission.

The degree of agreement ordinarily obtained with the visual, photo-electric, and thermoelectric methods is shown by several illustrations. The reliability of the nonvisual methods is checked by their agreement with the visual method at those wave lengths where the latter is reliable. In turn, the nonvisual methods serve to maintain the reliability of the measurements throughout the end regions of the visible spectrum where the sensibility of the eye is extremely low.

TWO NEW CRYSTALLINE DIFRUCTOSE ANHYDRIDES FROM HYDROLYZED INULIN

It has been shown by Jackson and Goergen (BUREAU OF STANDARDS JOURNAL OF RESEARCH, Vol. III, No. 1; July, 1929; RP+79) that inulin upon hydrolysis in aqueous solution with sulphuric acid yields a mixture of sugars, consisting of 92 per cent fructose, 3 per cent glucose, and 5 per cent of a group of nonreducing disaccharides, one of which was isolated in crystalline form and shown to be a difructose anhydride having a specific rotation of +27.0° for sodium light at 20° C.

From the mother liquors which were separated from the first difructose there was obtained a second crystalline substance which by elementary analysis and determination of molecular weight was shown to be a disaccharide of empirical formula $C_{12}H_{20}O_{10}$. It yielded upon hydrolysis with 0.2 normal sulphuric acid for 100 minutes at 100° C. 2 molecules of fructose. It was, therefore, designated Difructose Anhydride II. After careful purification it showed a rotation of +13.85 and a melting point of 198° C.

The mother liquors from which the second difructose had chystallized soon deposited a third crystalline substance which similarly showed an empirical formula of $C_{12}H_{20}O_{10}$. When treated with 0.2 normal sulphuric acid at 100° C. for 110 minutes it was partially hydrolyzed to a levorotatory substance which by chemical analysis was found to consist solely of fructose. It was, therefore, designated Difructose Anhydride III. The polariscopic analysis of the hydrolyzed sugar indicated the formation of an intermediate product of hydrolysis.

The purified substance showed a specific rotation of +135.64 and a melting point of 162° C.

From the 5 per cent nonreducing portion of hydrolyzed inulin have now been isolated the three difructose anhydrides whose properties are summarized in the following table:

Property studied	Difructose anhydride		
	I	II	III
Specific rotation (water).	+27.0	+13.85	+135.64
Melting point, ° C.	164	198	162
Crystalline form	Thin plates.	Truncated prisms.	Bipyramids.
Molecular weight (calculated 324).	307	310	308
Approximate solubility in water.[1]	32	32	38

[1] Expressed as grams of sugar in 100 grams of solution at 20° C.

The three sugars resemble each other in respect to their great resistance to hydrolysis and their comparatively slight solubility in water. They differ in rotatory power, crystalline structure, and melting point.

The mean rotation of the three sugars is +58.8, which is in essential agreement with the rotation (+55) of the nonreducing portion of hydrolyzed inulin as first isolated by Jackson and Goergen. This agreement indicates that the 5 per cent nonreducing substances consist solely of these three sugars occurring in equal proportions.

The results of this investigation corroborate the conclusions drawn in a previous article (BUREAU OF STANDARDS JOURNAL OF RESEARCH, vol. 5, No. 5; Nov. 1930; RP251) in which it was shown by arithmetical reasoning that a 5.2 per cent nonreducing portion of hydrolyzed inulin which consisted of three disaccharides occurring in equal proportions predicated a molecular weight of inulin of approximately 18,000.

A complete report of this work will appear in the April number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH.

PURITY OF REAGENT CHEMICALS

At the recent meeting of the American Chemical Society in Indianapolis, Edward Wichers, of the National Bureau of Standards, presented a paper summarizing the results of tests of over 200 reagent chemicals purchased for use in the bureau's laboratories during the last two and one-half years. About three-fourths of the chemicals tested, representing a considerable variety of materials whose purity is of much importance to the analytical chemist, were purchased under the

quality of specifications prepared by the society. Only two-thirds of the group of chemicals were found to conform entirely to the specified requirements.

Of the second group of chemicals, which were purchased under the general requirement of "analytical reagent quality," only 60 per cent were found to conform fully to the standards indicated by the labels on the containers. Considerable variations were found in the success of the different producers of these materials in meeting the requirements of their own standards or of the American Chemical Society specifications.

The paper included a discussion of a number of reagents of especially inferior quality, and pointed out means by which improvement can be made in the quality of reagent chemicals in general.

THE VIBRATION OF U BARS

An item under this title appeared on page 26 of Technical News Bulletin No. 167 (March, 1931). A typographical error occurs in the third paragraph. Beginning with line five the sentence should read: "In this connection a new proof is given of Rayleigh's method for determining the fundamental mode of vibration."

TURBULENCE IN WIND TUNNELS

One of the questions of current interest in aerodynamics is the desirability of having a large or a small turbulence in wind tunnels for the routine testing of airplane models. Based on a long series of experiments, the bureau has concluded that the wind tunnel should be so designed as to have small turbulence, because increased turbulence does not reproduce accurately the effect of increased scale of the model and because it is easier to introduce turbulence, if desired, than to remove it. The experiments in question were made in the bureau's 54-inch wind tunnel, in which various methods for reducing the turbulence were tried. Changes in the size and shape of the honeycomb cells had very little effect. The distance between the honeycomb and the measuring station was found to be the variable of primary importance, an increased distance resulting in a lower turbulence. An additional reduction was secured by using a large area reduction in the entrance cone, with the honeycomb at the extreme entrance end. It was not found practical to operate the tunnel without any honeycomb.

This work was conducted with the cooperation and financial assistance of the National Advisory Committee for Aeronautics. The measurement of turbulence was made by the use of spheres and by the hot wire anemometer described in National Advisory Committee for Aeronautics Technical Report No. 342.

WIND PRESSURE ON A MODEL OF A MILL BUILDING

In continuation of a program of investigation of wind pressure on structures, measurements have been made in the bureau's 10-foot wind tunnel on the distribution of pressure over a model of a mill building, both with and without a monitor ventilator. Speeds up to about 55 miles per hour were used, and there was little evidence of scale effect. The effect of the ground on which an actual building stands was simulated by a platform on which the model was mounted. Measurements were made for three wind directions—one normal to a side wall, one normal to an end wall, and one at 45°.

The maximum average loads were obtained with the wind at 45°, but in many cases fairly large areas were subjected to loads as great as twice the average load on the whole face. The loads on the roof of the monitor were greater than those on the roof of the main building, and in both cases the load was in such a direction as to lift the roof. The greater part of the model was subject to pressures lower than the static pressure.

The detailed results can not well be abstracted. The lowest pressure was below the static pressure by 3.3 times the velocity pressure, corresponding to a local loading of 47 pounds per square foot at a true speed of 75 miles per hour. This high loading was confined to an extremely small area on the roof of the monitor. Fairly large areas were subject to upward loads corresponding to 28 pounds per square foot at a true speed of 75 miles per hour. These values are computed on the assumption that the pressure within the building equals the static pressure, and, therefore, will be modified by the presence of open windows or other openings. The loads may be greater or less than those given, depending on the location of the openings and the direction of the wind.

The complete report of this investigation will be published in the April number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH.

PROGRESS IN AERONAUTIC RADIO RESEARCH

The bureau has made performance tests of its recently developed simultaneous radiotelephone and range beacon transmitter. This development permits an airplane pilot to receive simultaneously voice messages and visual radiobeacon signals, all on a single receiving set. Tests made at a distance with a commercial aircraft receiving set showed that the quality of the received speech signals is substantially better than that obtained in existing airplane radiotelephone reception, and that the operation of the beacon course indicator is equivalent to that obtained with existing visual type range beacons. Test flights were made to determine the useful distance range of the combined transmitter in its present adjustment. At a distance of 100 miles from the transmitting station it was still unnecessary to employ the full sensitivity of the receiving set. Increasing the effective height of the transmitting antenna system will result in still greater useful distance range. These results insure that simultaneous transmission of the broadcast and range beacon services and the simultaneous reception of these services on the airplane are entirely practicable for use on the airways.

A brief description of a radio system under development by the bureau as an aid to the prevention of collision between aircraft in flight under conditions of poor visibility was given on page 117 of Technical News Bulletin No. 164 (December, 1930). This system involves transmission of a warning signal on a very high frequency from each airplane and reception on the same frequency on each airplane. Upon receiving the warning signal from an airplane ahead of him, the pilot will maneuver his plane to reduce the intensity of received signal, thereby automatically deviating from the direction of danger. On account of the very high frequency and relatively short distance required, the power needed is very low. A transmitting set for this purpose has been constructed employing a single commercial receiving tube and operating on a frequency of 165,000 kilocycles. The receiving set also uses a single receiving tube of the same type in a very stable superregenerative circuit. To secure visual indication of the received signal, a copper-oxide rectifier and microammeter were connected to the output of the receiving set. A directional receiving antenna system was used, consisting of three doublet antennas approximately 3 feet long and spaced 18 inches apart, one being connected to the input of the receiving set. In preliminary tests a useful distance range of 3 miles was obtained, which is about the distance over which it would be desirable to have the collision-prevention system work. The apparatus does not yet have sufficient stability for practical application; the experiments continue.

An indicator has been developed at the bureau for the visual type radio range beacon which may have some advantages over the reed indicator regularly employed. In the new instrument a pointer remains at a zero mark when the airplane is on the course and swings to right or left as the airplane deviates from the course. Numerous flight tests have been made of this device and its practicability demonstrated. One of these instruments has been loaned to an air transport operator for service tests in regular operation flights in connection with a radio range beacon of the visual type installed on the airways. Until such tests are completed, it can not be stated whether this instrument is preferable to the reed indicator. The device is operated by a reed converter; that is, a reed indicator in which, besides the set of driving coils for operating each reed from the received beacon signals, a set of pick-up coils is provided for each reed. The motions of the two reeds induce alternating voltages in the two pick-up coils, which are proportional to the reed vibration amplitudes and, consequently, to the intensities of the two low frequencies constituting the received beacon signal. The induced alternating voltages are rectified by means of copper-oxide rectifiers and the rectified voltages applied in opposition to the terminals of the zero-center instrument which the pilot sees. One of the problems which had to be considered in connection with this instrument was the possibility that the beacon signals might stop, or the receiving set fail, and the instrument continuing to read zero, the pilot would be deceived into thinking his course was still being indicated. To preclude this possibility, a volume indicator is employed. A paper describing the new instrument is in preparation. When issued, a notice will be given in these columns.

DOMESTIC GAS BURNERS

The bureau has prepared Letter Circular No. 299, entitled "The Design of Gas Burners for Domestic Use," which is intended to answer most of the questions commonly asked by designers and manufacturers of gas-burning appliances regarding the technology involved in applying the combustion of gas to household uses.

An elementary description is given of the construction and operation of the Bunsen or blue-flame type of burner and of what takes place in a gas flame. This serves as an introduction to the more technical description of the effect of varying the form and size of the various parts of the burners, and the changes that are necessary to adapt burners for use with gases of different compositions.

While the material in the letter circular is intended primarily for the use of manufacturers of appliances, it should prove useful to gas fitters and others concerned with the adjustment of domestic appliances. This is a mimeographed letter circular, and the supply is limited. So long as the supply lasts copies may be obtained on application direct to the National Bureau of Standards.

PIPE-LINE CURRENTS AND SOIL RESISTIVITY

The present tendency in the protection of pipe lines against soil corrosion is away from a uniform coating for the entire length of the line and toward the application of coatings selected with respect to the corrosive character of the soils involved. This calls for a knowledge of varying soil conditions and a means of locating local corrosive soil areas. Such areas, commonly termed "hot spots," are prevalent in many types of soils, and it is in these regions that pipe lines suffer the greatest deterioration. The location of such corrosive areas is a matter of considerable importance, both with respect to the selection of coatings for new pipe lines and the reconditioning of old ones.

An extensive investigation of a dozen pipe lines ranging from the Gulf coast to southern Kansas revealed an apparent correlation between pipe-line currents, soil resistivity, and corrosion. Galvanic currents of measurable magnitudes were found to be flowing on all pipe lines examined. As a rule, lines were found to be collecting current in areas of normal and high soil resistivity and losing current in areas of low resistivity. Many cases of abrupt loss or discharge of current occurred in soils of unusually low resistivity. In such areas the pipe lines were found to be badly corroded.

Although no direct relation was found to exist between electrical resistivity of soils and their corrosiveness, abrupt changes in resistivity and unusually low resistivity were found to be significant with respect to corrosion. Soils having a resistivity of about 500 ohm centimeters or less were invariably found to be highly corrosive. A better relation between resistivity and corrosiveness exists in alkali than in acid soils.

To expedite the measurement of soil resistivity, a simple piece of apparatus was developed, consisting of two metal-tipped oak rods with a milliammeter mounted on one and a small flash-light battery on the other. By measuring the apparent resistance between the metal terminals, the approximate resistivity of the soil can be calculated if the constant of the apparatus is known. Since polarization is largely a cathode effect, it can be partly eliminated by making the cathode terminal much larger than the anode, thereby reducing the current density on it. A low resistance meter, such as a milliammeter, is found to be preferable to a voltmeter as with the former practically the full voltage of the test battery is applied between the electrodes, irrespective of the meter reading, while with the latter a large part of the battery voltage is consumed within the meter itself.

This apparatus permits of making frequent and rapid tests of earth resistivity along a pipe line or along a projected pipe line. Although it is not claimed that absolute values of resistivity are obtained with this apparatus, the results are sufficiently accurate for all practical purposes provided the soil is not too dry. It is important that earth be tested at the pipe level and where there is sufficient moisture to afford nearly maximum conductivity. Damp soil which will pack in the hand will usually show conductivity approaching that in a saturated condition.

The technique of surveying pipe lines for galvanic currents and other features of the investigation will be discussed in the April number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH.

WATER PENETRATION THROUGH BRICK AND MORTAR

As the result of a study of water penetration into brick masonry conducted at the bureau it has been shown that when the interior walls of brick buildings become wet during a rain it is likely that water has entered through open spaces between brick and mortar rather than directly through these solid materials. Such openings may be produced either by poor workmanship or by shrinkage of mortar. If there are no openings of this sort, the probability of penetration by water through solid 8-inch brick walls is exceedingly remote under normal climatic conditions and if proper precautions in the way of design have been taken. One very necessary precaution is to avoid plastering directly on the brick in an 8-inch wall, and this may be accomplished either by furring the wall or by the use of metal ties in place of header brick. The time required for water to travel through a brick, thence through a mortar joint, thence through another brick, is far greater than the time taken for water to penetrate the two bricks and the mortar joint when these materials are tested separately and out of contact with one another. Probably one reason for this is the fact that the pores in one material do not communicate directly with those in the other material. It is also known that a brick must become highly saturated before it transmits water to another material. This degree of saturation is not attained when the brick is merely wetted through.

MODULUS OF RUPTURE OF SOME OHIO HEAVY CLAYS

In the heavy clay investigation being carried on at the Columbus branch of the bureau the determination of the modulus of rupture on the fired bars has just been completed. Both the highest and the lowest values were found with the alluvial clays, being 4,225 and 1,560 pounds/inches^2, respectively. The average value for eight such clays was 2,860 pounds/inches^2. For the same clays in the green state an average value of 320 pounds/inches^2 was obtained.

The seven glacial clays show an average value of 2,495 pounds/inches^2, varying between 2,145 and 2,890. In the green state these have an average modulus of rupture of 625 pounds/inches^2.

Eleven shales showed a variation from 2,380 to 3,705, averaging 2,890 pounds/inches^2. The green bars average 230 pounds/inches^2.

It is interesting to note that of the three classes of clays the glacial clays gave the highest average modulus of rupture in the green state and the lowest average in the fired condition, while the shales showed the lowest average when green and the highest average when fired.

THERMAL EXPANSION OF SOME SODA-LIME GLASSES

In TECHNICAL NEWS BULLETIN No. 163 (November, 1930) a statement was published regarding a method for computing the thermal expansion of soda-lime glasses from room temperature to the "critical temperature."

Further study of the data obtained has led to two new equations from which the expansion of the glasses considered can be computed with considerable accuracy in the temperature ranges 25° to 100° C. and 100° to 400° C.

The expressions are:

$$E25°\text{–}100° = 0.004\ P_1 + 0.325\ P_2 + 0.125\ P_3 - 0.00186(P_2 + P_3)^2$$

$$E100°\text{–}400° = 0.015\ P_1 + 1.655\ P_2 + 0.655\ P_3 - 0.0045(P_2 + P_3)^2 - 0.6$$

in which E is the increase in length expressed in microns per centimeter between the temperatures indicated, and P_1, P_2, and P_3 are the percentages of silica, soda, and lime, respectively. Further studies of the expansion data are being made to see if the "critical temperatures" and the initial softening points can be computed.

PHORMIUM TENAX FOR PAPER MAKING

Research Paper No. 285, The Paper-Making Properties of Phormium Tenax (New Zealand Flax), was published in the March, 1931, issue of the BUREAU OF STANDARDS JOURNAL OF RESEARCH. This reports the results of experimental paper-making tests of this material in the bureau paper mill.

At the present time phormium tenax is used principally for cordage, both alone and in combination with manila, which it resembles in appearance. The fiber is obtained from the leaves of a native plant of New Zealand, and was for a long time commonly known

in the markets as New Zealand flax. The plant is cultivated in New Zealand to only a limited extent, but reports state that if the demand warranted, it could be produced on a scale sufficient for commercial consideration for paper making.

Three representative samples—unscutched, scutched, and tow—were employed in the paper-making tests. The material was supplied by the New Zealand Department of Scientific and Industrial Research. The tests were made on both laboratory and semicommercial scale.

To dissolve and eliminate the nonfibrous tissue and other impurities the phormium was cooked under pressure, and after being washed, the pulp was bleached with calcium hypochlorite solution. In a number of the tests the preparation of the pulp included two successive cooking operations, fractional digestion. After the completion of the first boiling, the liquor was drained off, the fresh solution was added, and the operation was continued. Caustic soda, sodium sulphite, lime, soda ash, and a mixture of caustic soda and sodium sulphide were each used as digestion agents. The most satisfactory digestion procedure depends somewhat upon mill conditions. In the work at the bureau either the caustic-soda process or the 2-stage cooks using sodium sulphite and caustic soda, respectively, gave very good results on the basis of both quality of fiber produced and yield obtained. No special equipment is required for the caustic-soda process, whereas when sodium sulphite is employed the boiler should be made of an acid-resistant material.

In the semicommercial runs frequently the paper seemed tough and strong when leaving the presses, but after going over the dryers was somewhat brittle and had lost considerable of its strength. Apparently the lignin, natural waxes, etc., were not all removed in the cooking, washing, and bleaching operations, and when subjected to the heat of the dryers made the paper brittle.

The tests indicate that phormium is suitable for the manufacture of wrapping or writing papers, but that the fiber needs to be thoroughly cleaned mechanically before being submitted to the paper-making processes. The scutched material, that from which the greatest amount of the nonfibrous tissue has been removed, showed the best possibilities.

The publication contains data relative to the kind and amount of chemicals used in the cooking liquor, yield of unbleached pulp, bleaching quality of the pulp, and physical and chemical properties of the papers made.

CERTIFICATION AND LABELING

Desire to cooperate with the bureau in making the certification and labeling plans effective has been expressed by several associations interested in various types of building materials, including roofing, lumber, brick, metal lath, plaster, and structural tile.

On March 17 the Associated Metal Lath Manufacturers voted to request the bureau to include metal lath in its certification plan. The significance of this action will be appreciated when it is known that the association (and also the Concrete Reinforcing Steel Institute) had expressed some hesitancy in carrying forward such standardization because of the supposed possibility of opposition on behalf of the Federal Trade Commission. This commission stated recently that it regards the work of the Department of Commerce in encouraging standardization of commodities as important and beneficial to the public, and that it regards the promotion of standardization of commodities among the members of an industry as peculiarly the work of this department. In no case has the commission ever held standardization of commodities by the members of an industry to be a violation of any of the statutes which the commission is required by law to enforce.

The Structural Clay Tile Association, which has been basing its quality labels on the standards of the American Society for Testing Materials, has expressed a desire to include a suitable reference to the Federal specifications, and to act as an inspection agency in "policing" the labels.

In cooperation with the trade association department of the Chamber of Commerce of the United States the bureau has been collecting copies of labels or their equivalent used by various organizations for identifying commodities complying with the requirements of the specifications or standards of these associations. The chamber of commerce is arranging a "loan exhibit" of the association labels.

NEW AND REVISED PUBLICATIONS ISSUED DURING MARCH, 1931

Journal of Research[1]

Bureau of Standards Journal of Research, Vol. 6, No. 3, March, 1931 (RP Nos. 279 to 291, inclusive). Price, 40 cents. Obtainable by subscription. (See footnote.)

Research Papers[1]

(Reprints from Journal of Research)

RP259. The heat of formation of water; F. D. Rossini. Price, 10 cents.

RP260. The heats of combustion of methane and carbon monoxide; F. D. Rossini. Price, 5 cents.

RP262. Prism size and orientation in minimum-deviation refractometry; L. W. Tilton. Price, 10 cents.

RP264. Viscous flow and surface films; R. Bulkley. Price, 10 cents.

RP265. Determination of magnesium in Portland cement and similar materials by the use of 8-hydroxyquinoline; J. C. Redmond and H. A. Bright. Price, 5 cents.

RP267. Determination of small quantities of volatile organic acids in sulphuric acid solutions; D. N. Craig. Price, 5 cents.

RP268. Strain measurement in the reinforcement for the dome of the Natural History Building; W. C. Lyon, H. L. Whittemore, A. H. Stang, and L. R. Sweetman. Price, 15 cents.

RP269. A radio method for synchronizing recording apparatus; T. Parkinson and T. R. Gilliland. Price, 10 cents.

RP270. The tensile properties of alloy steels at elevated temperatures as determined by the "short-time" method; W. Kahlbaum, R. L. Dowdell, and W. A. Tucker. Price, 15 cents.

RP271. Further studies of the X-ray standard ionization chamber diaphragm system; L. S. Taylor and G. Singer. Price, 10 cents.

RP272. An optical coincidence gage; I. C. Gardner and F. A. Case. Price, 10 cents.

RP274. Probabilities of recombination into the 1^1S state of caesium; C. Boeckner. Price, 10 cents.

RP275. Regularities in the second spectrum of xenon; C. J. Humphreys, T. L. de Bruin, and W. F. Meggers. Price, 5 cents.

RP276. The resistance of chromium-plated gages to wear; H. K. Herschman. Price, 10 cents.

RP278. Critical study of the bursting strength test for paper; F. T. Carson and F. V. Worthington. Price, 10 cents.

Simplified Practice Recommendations[1]

R2–30 (2d ed.). Bedsteads, springs, and mattresses. Price, 5 cents.

R94–30. Open web steel joists. Price, 5 cents.

R97–30. Bell - bottom screw jacks. Price, 5 cents.

R113–30. Restaurant - guest checks. Price, 5 cents.

Miscellaneous Publications[1]

M114. Filters for the reproduction of sunlight and daylight and the determination of color temperature; R. Davis and K. S. Gibson. Price, 45 cents.

M116. Report of the twenty-third national conference on weights and measures attended by representatives from various States held at the Bureau of Standards, Washington, D. C., June 3, 4, 5, and 6, 1930. Price, 35 cents.

M119. Standards Yearbook, 1931. Price, $1; foreign, $1.20.

Commercial Standards Monthly[1]

Commercial Standards Monthly, Vol. 7, No. 9; March, 1931. Price, 10 cents. Obtainable by subscription. (See footnote.)

Technical News Bulletin[1]

Technical News Bulletin No. 167, March, 1931. Price, 5 cents. Obtainable by subscription. (See footnote.)

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[1] Send orders for publications under this heading with remittance only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to TECHNICAL NEWS BULLETIN, 25 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 40 cents. Subscription to JOURNAL OF RESEARCH, $2.75 per year; other countries, $3.50. Subscription to COMMERCIAL STANDARDS MONTHLY, $1 per year; other countries, $1.25.

LETTER CIRCULARS PREPARED DURING MARCH, 1931 [2]

LC297. Electric and gas refrigerators. (Replaces LC–255.)

LC298. Automobile engine lubricating oils.

LC299. Design of gas burners for domestic use.

OUTSIDE PUBLICATIONS [3]

Solar and magnetic activity and radio transmission. L. W. Austin, E. B. Judson, and I. J. Wymore-Shiel; Proceedings, Institute of Radio Engineers (New York, N. Y.), vol. 18, No. 12, p. 1997; December, 1930.

Radio-frequency is checked by Bureau of Standards meter. C. G. McIlwraith; United States Daily (Washington, D. C.), Vol. VI, No. 26, p. 5; April 2, 1931.

A. G. A. Bureau of Standards field study of long gas lines. Scott Ewing; American Gas Association Monthly (New York, N. Y.), Vol. XIII, No. 2, p. 70; February, 1931.

Suggests local union safety committees. M. G. Lloyd; Journal of Electrical Workers and Operators (Washington, D. C.), Vol. XXX, No. 3, p. 117; March, 1931.

Lightning. M. G. Lloyd; Proceedings, International Association of Municipal Electricians (Municipal Building, West New York, N. J.), p. 65; 1930.

Work of Federal Fire Council. S. H. Ingberg; United States Daily (Washington, D. C.), Vol. VI, No. 7, p. 10; March 11, 1931.

A comparison of methods for determining gum contents of gasolines. O. C. Bridgeman and E. W. Aldrich; Society of Automotive Engineers Journal (New York, N. Y.), Vol. XXVIII, No. 2, p. 191; February, 1931.

A survey of current automobile and bus fuel-line temperatures. O. C. Bridgeman and H. S. White; Society of Automotive Engineers Journal (New York, N. Y.), Vol. XXVIII, No. 3, p. 315; March, 1931.

The gaseous explosive reaction—the effect of pressure on the rate of propagation of the reaction zone and upon the rate of molecular transformation. F. W. Stevens; National Advisory Committee for Aeronautics (Washington, D. C.), Technical Report No. 372; 1930.

Devices alleged to cure baldness by means of ultraviolet and infra-red rays. W. W. Coblentz; Journal American Medical Association (Chicago, Ill.), Vol. 96, p. 527; February 14, 1931.

Silk in the molecular still. R. T. Mease and W. D. Appel; American Dyestuff Reporter (New York, N. Y.), Vol. 20, p. 155; March 2, 1931.

Procedure control in aircraft welding. H. L. Whittemore, J. J. Crowe, and H. H. Moss; Proceedings American Society for Testing Materials (Philadelphia, Pa.), Vol. 30, Part II, p. 140; 1930.

Discussion: Aircraft materials. L. B. Tuckerman; Proceedings American Society for Testing Materials, (Philadelphia, Pa.), Vol. 30, Part II, p. 175; 1930.

Discussion: Failures of aircraft engine parts and causes thereof, by T. T. Neill. L. B. Tuckerman; Proceedings, American Society for Testing Materials (Philadelphia, Pa.), Vol. 30, Part II, p. 195; 1930.

Discussion: Specimens for torsion tests of metals, by R. L. Templin and R. L. Moore. L. B. Tuckerman; Proceedings, American Society for Testing Materials (Philadelphia, Pa.), Vol. 30, Part II, p. 545; 1930.

A study of Young's eriometer and its application in the grading of wool. H. J. McNicholas and H. J. Curtis; The Melliand (Wollaston, Mass.), Vol. 2, p. 1555; March, 1931.

Frost—no decay—How to prevent it. D. W. Kessler; American Architect (New York, N. Y.), Vol. CXXXIX, No. 2592, p. 28; February, 1931.

Simplifying equipment saves millions yearly. G. A. Cooper; Electrical World (New York, N. Y.), Vol. 97, No. 4, p. 185; January 24, 1931.

Plural fractions. C. E. Waters; Science (New York, N. Y.), Vol. 73, No. 1886, p. 210; February 20, 1931.

The Bureau of Standards. George K. Burgess; Civil Engineering (New York, N. Y.), Vol. 1, No. 6, p. 491; March, 1931.

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[2] "Letter circulars" are in mimeographed form and are designed primarily to answer specific inquiries. The supply is necessarily limited so that in general but one copy can be sent in answer to each request. Copies are available only on application to the Bureau of Standards, Washington, D. C. No mailing list is maintained for "letter circulars" and complete sets of back numbers can not be furnished.

[3] "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

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